E C O N O M I C S B U L L E T I N

Hedonic Models and Pre-Auction Estimates: Abstract Art Revisited

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Abstract

We investigate the predictive power of hedonic models compared to that of pre-auction estimates in the context of art auctions. We use a panel data consisting of abstract paintings and a methodology that employs the estimates as instrumental variables in the framework of a hedonic regression model. The results suggest that hedonic models have no better predictive power than that of the estimates. Pre-auction estimates appear to fully account for the available public information on works of art.

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1. Introduction

In the fall of 1999, Christie's was chosen to auction a painting by Karel Appel titled "Child." Christie's experts in Amsterdam got busy at once examining the piece. They inspected the condition of the canvas with a sharp eye: they looked for cracks, tears, scratches, and spots. They also gathered information on the history of the painting and its previous owners. Then, they re-examined Karel Appel's entire body of work and considered recent trends in the art market. In the end, the experts concluded that "Child" would most likely fetch between $5,500 and $7,000. The painting thus became *Lot 252* and some time later was carried by cautious hands into the auction room at Cornelis Schuytstraat 57. Much to everyone's amazement it sold for close to $110,000. This naturally begs the question: How much do auction house experts know about the value of the artwork they are appraising?

The auctioning process starts when the owner of the artwork contacts the auction house with the intention to sell. The artwork is examined by specialists who determine its approximate worth. The minimum price that the owner is willing to accept –called reserve or reservation price – plays a particularly interesting role here. For reasons that are obvious, the pre-auction estimate range has to be set above the reservation price. The reservation price is mutually agreed upon by the owner of the artwork and the auction house.

In addition to the reservation price, pre-auction estimates account for many other types of information, such as the reputation of the painter, the location of the sale, subject matter, the condition of the artwork, financial market outlook, etc. It is pertinent to assume that due to the nature of their profession, art experts are in the best position to have knowledge of all these factors, and hence come with the best possible estimate of expected hammer prices.

Most of the research on art auctions prices is concerned with the biasedness of pre-auction estimates. Biasedness is usually measured with respect to the midpoint of the estimation interval. One of the questions we ask here, however, is whether pre-auction estimates make for a better predictor of art prices than the information already available to the public (information that can be summarized by a hedonic model). In order to tackle this issue we use a panel data consisting of abstract paintings. By choosing abstract art we seek to control for the influence of subject matter – a crucial determinant of art prices that is poorly understood and difficult to quantify. Our methodology employs the pre-auction estimates as instrumental variables, together with a hedonic regression model whose independent variable is the hammer price.

The paper is organized as follows: The next section discusses our approach in the context of previous research. Section three discusses the determinants of art prices that are usually included in hedonic regression models. Section four presents the panel data and section five discusses the methodology and results. Section six concludes.

2. Motivation and Goal

A majority of studies on the informational efficiency of art auctions focus on the biasedness of the pre-auction estimates. The findings are mixed.

Beggs and Graddy (1997) suggest that larger paintings - especially Impressionist Art - tend to be underestimated by the experts. However, they also find that recently executed Contemporary Art pieces tend to be overestimated. Bauwens and Ginsburgh (2000) find that both Christie's and Sotheby's underestimates English silver coffee- and teapots sold between 1976 and 1991. Chanel et al. (1996) find that the pre-auction estimates for jewellery auctions are

systematically below hammer prices. D'Souza and Prentice (2001) produce similar findings. Ekelund et al. (1998) find that in 18 years out of 20, the average price of artwork was larger than the average guess, although the overall mean bias of 2.7 percent suggests overestimation. The authors investigated Latin American Art auctions conducted by Christie's and Sotheby's between 1977 and 1996.

Mei and Moses (2005) find that high estimates are associated with subsequent adverse abnormal return for periods of up to thirty years. The authors conclude that auction houses overestimate expensive artworks in order to reap the maximum commissions and premiums.

Lourgand and McDaniel (1991) research Sotheby's auctions of Americana and conclude that buyers and sellers participate in a fair game. Ashenfelter (1989) contends that experts' estimates are truthful in the sense that they are unbiased predictors of art prices.

There are, however, relatively few studies investigating the extent to which pre-auction estimates account for the available public information on artworks. Bauwens and Ginsburgh (2000) contend that the experts do not take into account all available information when producing their estimates. Abowd and Ashenfelter (1988), however, suggest that pre-auction estimates are better predictors of prices than hedonic price functions. Czujack and Martins (2004) find that pre-auction estimates represent good predictions of the subsequent hammer price. Finally, Valsan and Sproule (2005) contend that the issue of an estimate's biasedness is uninteresting because reservation prices constrain the low estimate in such a way that we are likely to observe overestimation. What really matters is the degree to which the estimates incorporate the already available information.

We set out to re-examine the informational content of pre-auction estimates; the goal is to establish if pre-auction estimates have the same predictive power as hedonic models. We hypothesize they do. We establish next a list of relevant explanatory variables to be included in a hedonic model; if auction house experts make an honest effort to provide a truthful estimation, the hedonic model should explain the variation in hammer prices no better than the pre-auction estimates.

3. Determinants of Estimates and Prices

There is a solid body of literature documenting the relationship between several consecrated variables and the market value of art. In general, all reputable and aspiring research includes the following usual suspects in a hedonic regression model[1].

(i) Reputation: An artist's reputation is probably the strongest and most obvious measurable determinant of pre-auction estimates and prices. Reputation is defined by style, artistic agenda, the folklore surrounding the life of the artist, the context of the historical period, and other factors, many of them unbeknownst to our inquiry. While the perception of the market can change over the long-run, the "rating" of artists tends to remain relatively stable over extended periods of time.

(ii) Medium: Oil-on-canvas paintings usually command a premium over watercolors, tempera, and acrylics, other things equal. Oils-on-canvas are extremely sturdy: they endure the passage of

[1] Hedonic models allow for the construction of price indexes while properly accounting for the characteristics of the product whose price is analyzed. Court (1939) first studied the changes in automobile prices over time in relation to performance characteristics. Gregory Chow (1967) used a similar approach to measure the impact of technological changes on computer prices. Ever since, research on the economics of the arts has adopted this methodology on a grand scale.

time and can withstand wide variations in humidity, temperature, and even light (to some degree). Oils are forgiving to hazards, such as shocks, abrasions, and vibrations. In addition oils have an artistic versatility not attained by any other medium.

(iii) Subject Matter and/or Theme: This element represents yet another important determinant of estimates and prices. However, subject matter is difficult to quantify. It is not well understood how art lovers and investors perceive subject matter at the aggregate level. It is therefore difficult to understand the mechanism by which portraits and landscapes lend value to an artwork. There is no lack of attempts at quantifying this variable [Renneboog and Van Houtte (2002), Agnello (2002), D'Souza and Prentice (2001)]. Valsan (2002) has subjectively divided painting into landscapes, portraits, still-lifes, and compositions. Wieand et al. (1998) have even engaged, with a lot of courage in the unlikely exercise of counting and categorizing people, buildings, and other elements of motif. To complicate matters even more, some paintings occupy a special place within the artistic and representational mythology surrounding an artist or an historical period. Paul Klee is known to have incorporated letters and numbers in *some* of his paintings, endowing them with a special symbolism.

(iv) Auction House: The market status and prestige of the auction house is another determinant of pre-auction estimates and art prices. There is a two-way relationship at play here: more prestigious art houses – such as Sotheby's and Christie's – attract more expensive and influential artwork. On the other hand, paintings auctioned by higher-status auction houses tend to be perceived as being trendier and more valuable.

(v) Market: The temporal and geographic coordinates of art auctions are known to influence the market value of art. Hedonic price indices always include dummy variables accounting for period and location. The art market undergoes alternating periods of expansion and contraction, just like the stock market. It was bullish towards the end of the 1980s, fuelled by an expanding US economy and the aggressive bidding from Japanese collectors and investors. During this period, Impressionists and Post-Impressionist art set new price records: Van Gogh's *Sunflowers* sold for over $40 m and *Le portrait du docteur Gachet* fetched $78 m. The early 1990s saw a major retreat in art prices. This trend reversed towards the end of the 1990s, when another bull market ensued, and the price of art soared again. The passage of time also left its mark on the geographical dimension of the art market. Paris slowly relinquished its role as the art capital of the world to New York City. With the ascent of abstract expressionism and pop culture, the skyline of Manhattan became the symbol for cultural and financial opulence. New York stands now as the foremost art hub of the world.

(vi) Characteristics of The Buyer: One paramount factor in an art auction is the bidder. Each buyer walks into the auction with a unique blend of aesthetic credo, investment knowledge, wealth, and even prejudice. In some cases, an auction house might hold close ties to its most important clients, and have therefore knowledge of some of these traits. In other cases, the bidder may be a perfect stranger, a totally unknown variable, a wild card whose deep pockets could upset the bidding sequence and make tomorrow's headlines. In any case, it is extremely difficult

to quantify the many characteristics of the buyer that can make a difference. This aspect is conspicuous by its absence from the research on art markets, and it is not difficult to guess why[2].

4. The Data

We use an instrumental variable approach applied to a relatively homogenous sample of observations. As explained earlier, we select only abstract art, because subject matter is one of the least quantifiable determinants of art prices. We require 150 valid observations to include a painter in our sample. Our panel data consists of four major modern European artists: Vassily Kandinsky, Juan Miro, Paul Klee, and Karel Appel. All these four artists share a strong stylistic and conceptual connection. The source of data is ADEC International, a Paris-based organization that gathers and organizes auction data from around the world. The period covered ranges from 1986 to 2003.

Vassily Kandinsky was born in Moscow in 1866, and from an early age was captivated by music and painting. As a teenager, he taught himself to play the piano and cello. Initially, he studied Law and Economics, and even lectured at the Moscow Faculty of Law. Later on, he held academic positions in Art in Moscow, both during and after the Bolshevik Revolution, and in Germany, where he taught at the Bauhaus. Initially influenced by impressionists and fauvists, Kandinsky eventually turned to abstractionism. He founded the legendary group *The Blue Rider*. Both the Bolsheviks and Nazis despised Kandinsky's avant-garde art. The Nazis included his paintings in the infamous exhibition showcasing degenerate art. A herald of pure abstraction in art, Kandinsky influenced abstract expressionism in the post-World War II era. He is considered one of the most influential modern artists.

Paul Klee was born in Switzerland in 1879. He grew up in a family of musicians and became a violinist himself. Klee opted for a painting career, and subsequently joined *The Blue Rider*. Like Kandinsky, Klee taught at Bauhaus in Germany and fled Germany shortly after 1933. In his wake, the Nazis branded his art as degenerate. Later, he became ill with a degenerative muscular and skin disease that eventually killed him in 1940. Klee is revered as a masterful colorist and one of the most remarkable abstract painters. His art vibrates with an eclectic mix of influences from impressionists, fauvists, cubists, surrealists, and symbolists.

Juan Miro was born in Barcelona in 1893, and he initially studied accounting because his parents wanted him to have respectable job. Miro, however, was inexorably attracted to art and eventually became a painter. His art was influenced early on by impressionists and fauvists, but later on he turned surrealist and then abstract. In the 1920s, he moved to Paris, where Ernest Hemingway bought his painting, *The Farm*. Miro is considered extremely original –even eccentric. His unique style is widely recognizable. His conceptual approach to art is now lore: Miro has envisioned bold new concepts, such as gas sculpture and four-dimensional painting.

Karel Appel was born in Amsterdam in 1921, in a land rife with artistic talent. He was destined to carry on the tradition of great Dutch masters, from van Eyck, Rubens, Hals, Rembrandt, to van Dongen and Mondrian. Appel's artistic path laid the foundation of modern European Abstract Expressionism. He is one of the exponents of the European group *CoBra*. Appel – a modern Holland cultural icon- is currently one of the most famous abstract painters still alive.

[2] There are very few exceptions: a relatively recent study by Pommerehne et al. (1997) investigates the behavior of museums in the acquisitions of artwork and finds that they tend to overpay.

Table I. Sample statistics

	Vassily Kandinsky	Paul Klee	Juan Miro	Karel Appel	Total sample
Number of paintings	194	427	646	1,041	2,308
Average low estimate	$145.21	$189.54	$70.75	$4.09	$68.94
Average high estimate	$203.51	$257.69	$102.86	$5.61	$96.12
Average hammer price	$188.39	$222.01	$100.01	$4.91	$87.14
Landscape-oriented	51%	55%	42%	52%	50%
Oil on canvas	30%	5%	23%	62%	38%
Auctioned by Sotheby's	43%	45%	44%	28%	37%
Auctioned by Christie's	40%	42%	37%	40%	40%
Auctioned in Paris	4%	2%	12%	8%	7%
Auctioned in London	50%	36%	34%	24%	31%
Auctioned in Amsterdam	0%	0%	0.3%	29%	13%
Auctioned in New York	34%	50%	45%	14%	31%

Sample statistics are presented in Table I. All dollar figures are calculated on a per square-inch basis. All figures are rounded-off to the second decimal.In total, there are 2,308 paintings. Karel Appel accounts for almost half of the sample with 1,041 artworks. He is also the painter with the lowest market value of the above four, maybe because he is the only one of the four artists still alive. Appel's paintings are valued at a mere $5 per square inch as compared to the average of $87 per square inch (entire sample), or $222 per square inch (Paul Klee). Vassily Kandinsky trails Klee very closely in terms of market value. Juan Miro comes in third place.

About 40% of all artworks are oil on canvas. Karel Appel and Paul Klee stand here, yet again, at the two opposing ends of the spectrum. Only 5% of Klee's paintings are oil on canvas, while Karel Appel boasts 62%. This difference is due in part to the different techniques that these two painters employed, but could also be an artifact of the tremendous market value differential between Klee and Appel. The higher rated the painter, the wider the range of works auctioned, including sketches, unfinished paintings, and even doodles. Appel probably accounts for more oil on canvas paintings simply because many of his sketches are not deemed worthy of selling in auction. By contrast, the high reputation enjoyed by the Swiss-born Klee makes every piece of work produced by his hand a valuable artifact[3].

Christie's and Sotheby's dominate the auction market, accounting for roughly 77% of paintings in our sample. The remaining 20 or so auction houses in our sample account for the remaining 23% of artworks. The data presented above confirm yet again the leading cultural role played by New York City. Surprisingly, London appears to share a similar status, while Paris trails in a distant fourth place, slightly behind Amsterdam. New York and London appear to represent the largest and most famous art, and financial, centers in the world.

[3] Picasso had a knack for turning all his creations into masterpieces. He is one of the most prolific artists ever; although he lived to an old age, he could not have produced so much unless one counts in every drawing and doodle.

Table II: Regression results[4]

Variables	(1)	(2)	(3) Semi-reduced	(3) Reduced	(4) Semi-reduced	(4) Reduced
Intercept	66.299 (3.243)	88.192 (2.935)	2.043 (0.071)	3.874 (0.721)	-5.522 (-0.181)	1.985 (0.366)
Miro	-71.538*** (-5.995)	-95.302*** (-5.434)	4.046 (0.187)	-	5.311 (0.240)	
Appel	-149.435*** (-5.999)	-208.719*** (-11.659)	-8.472 (-0.247)		1.667 (0.045)	-
Klee	57.319*** (4.509)	71.917*** (3.850)	-21.425 (-1.055)	-	-17.578 (-0.870)	-
Medium	51.738*** (7.237)	71.015*** (6.760)	1.949 (0.136)	-	0.309 (0.021)	-
Orientation	-4.189 (-0.69)	-3.534 (-0.008)	-2.032 (-0.248)	-	-3.731 (-0.456)	-
New York	48.588** (2.508)	69.340** (2.436)	-10.106 (-0.364)	-	-14.631 (-0.519)	-
London	33.932* (1.751)	49.786* (1.749)	-10.968 (-0.412)	-	-16.292 (-0.606)	-
Amsterdam	33.465* (1.616)	49.711* (1.634)	-12.735 (-0.448)	-	-16.809 (-0.586)	-
Paris	6.340 (0.467)	4.345 (0.218	3.316 (0.183)	-	6.501 (0.358)	-
Christie's	-16.139 (-0.830)	-25.491 (-0.892)	26.069 (0.989)	-	28.900 (1.092)	-
Sotheby's	-8.237 (-0.414)	-13.475 (-0.461)	11.004 (0.421)	-	14.116 (0.527)	-
$\hat{P}_{Low}$	-	-	1.242*** (6.258)	1.208*** (23.594)	-	-
$\hat{P}_{High}$	-	-	-		0.938*** (6.029)	0.886*** (23.577)
R^2	0.236	0.210	0.196	0.196	0.195	0.195
Adjusted R^2	0.226	0.200	0.195	0.195	0.195	0.195
F-Statistic	24.919	21.409	556.682	556.682	193.735	555.858
Sample Size	2289	2289	2289	2289	2289	2289

[4] Notes: (a) The parentheses contain the t-statistics. (b) " * " denotes significance at the .05 level, and " ** " denotes significance at the .01 level.

5. Methodology and Results

We want to estimate the relationship between pre-auction estimates and hammer prices, but are faced with a classical econometric problem. Both low and high estimates are dependent on a series of known factors such as artist reputation, auction house, media, date of auctioning, etc.; at the same time, hammer prices also reflect the same information. Hence, we cannot include the low and high estimate together in a hedonic regression whose dependent variable is the hammer price. We have therefore chosen to utilize the low and high estimates as instrumental variables. We first regress these two variables against what we believe constitutes a relative comprehensive list of explanatory variables. We then include the fitted low and high estimates as explanatory variables in a hedonic regression whose dependent variable is the hammer price:

$$P_{Low,i} = \beta_o + \sum_{j=1}^{m} \beta_j X_{i,j} + \sum_{k=1}^{n} \phi_k D_{i,k} + u_{1,i} \quad (1)$$

$$P_{High,i} = \beta_o + \sum_{j=1}^{m} \beta_j X_{i,j} + \sum_{k=1}^{n} \phi_k D_{i,k} + u_{2,i} \quad (2)$$

$$P_{Hammer,i} = \beta_o + \sum_{j=1}^{m} \beta_j X_{i,j} + \beta_{k+1} \hat{P}_{Low,i} + u_{3,i} \quad (3)$$

$$P_{Hammer,i} = \beta_o + \sum_{j=1}^{m} \beta_j X_{i,j} + \beta_{k+2} \hat{P}_{High,i} + u_{4,i} \quad (4)$$

where:
P_{Low} = Low pre-auction estimate
P_{High} = High pre-auction estimate
$\hat{P}_{Low}$ = Instrumental variable for the low pre-auction estimate
$\hat{P}_{High}$ = Instrumental variable for the high pre-auction estimate
P_{Hammer} = Hammer price
X_j = Dummy variables accounting for the years 1987 – 2003
D_i = Dummy variables accounting for artist reputation, media, auction houses, and location

The results are presented in Table II. As expected, the coefficients of dummy variables show Karel Appel as the lowest rated painter of the group in terms of market value. Paul Klee is the highest rated, followed by Kandinsky, and Juan Miro in third place. Artwork executed in oil-on-canvas tends to be significantly more expensive than other techniques. The more expensive pieces are sold in New York City and London. The dummy coefficients for Amsterdam and Paris, however, are only marginally significant (or, alternatively, the standard deviation of estimated coefficients tends to be rather larger). One might argue that the lack of significance in these estimated coefficients is due to the thinness of the market; while true, this assertion only reinforces the conclusion that Paris has lost its status as the premier art center of the world. Surprisingly, the dummy coefficients for Christie's and Sotheby's are statistically insignificant.

The most important findings are revealed by inspecting the results of regressions (3) and (4). Model (3) is estimated in a full hedonic specification, in a semi-reduced hedonic specification, (after removing the yearly dummy variables) and in a reduced specification (after

removing all dummy variables). The reduced model, amazingly, retains the same explanatory power (the Wald test is not significant) as the other two versions. Statistically, the reduced model represents the best fit[5]. The same is true of model (4). This clearly indicates that the information contained by the full hedonic model is wholly accounted for by the low and high pre-auction estimate[6]. Our findings do not necessarily imply market efficiency, but we do acknowledge that pre-auction estimates undoubtedly have a significant and relevant informational content.

We are somewhat surprised by the magnitude of the estimated coefficients for the low and high pre-auction estimate. It appears that hammer prices are more sensitive to the variations in the low pre-auction estimate than to those in the high pre-auction estimate. We are reminded, however, that the middle of the estimation interval is seldom an unbiased estimator of hammer price. This is due to the presence of constraints such as the reservation prices and the need to maximize participation of both sellers and bidders. More specifically, the low estimate is subject to more constraints because the reservation price is only interfering with the inferior bound of the estimation interval, while leaving the superior bound unaffected [Valsan and Sproule (2005)].

We therefore construe these results as evidence of: a) the effort made by auction houses to contain the expected hammer price within the boundaries of the estimation interval, and b) the perception that the low estimate is constrained by the reservation price. Art buyers are probably considering the low estimate more relevant because it conveys more information than the high estimate. They are probably aware that the winning bid cannot be much lower than the low pre-auction estimate; hence variations in the low estimate could be more closely scrutinized. In the end, however, too close a scrutiny could beget overreaction.

6. Conclusions

The question of predicting art auctions prices is a topic that has received considerable attention lately. Most of the cited academic papers, however have concentrated on measuring the biasedness of the pre-auction estimates.

In this paper, we have investigated the extent to which hedonic models stack up against pre-auction estimates in terms of predictive power. To this end we have used a relatively homogenous panel data consisting of abstract paintings. The artists featured in our sample – all four of them European – share a strong connection in terms of artistic agenda, influences, and historical context. The data have been analyzed using the pre-auction estimates as instrumental variables, in the context of a hedonic regression model.

In the end, the results are insightful. To the conclusions brought forward by previous studies, we attach our findings: we suggest that hedonic models add little or no predictive power above and beyond that of the pre-auction estimates. While our research does not necessarily represent an exercise in testing the informational efficiency of art auctions, it does strongly suggest that art auctions – at least in the case of four European abstract painters – are close to representing a fair game. It also reinforces the belief that art experts have genuine skills in appraising the market value of art.

[5] The full hedonic model is over-specified and has multi-colinearity problems.. Citing this reason as well as other constraints we have chosen not to report the results of the full model.

[6] This holds true only with respect to the list of factors or determinants of art value that we put forth here. Whether our list is complete and the determinants are relevant is a different question altogether. In producing the hedonic model, however, we followed previous research.

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